NON-PROVISIONAL PATENT APPLICATION

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TITLE: METHOD AND APPARATUS FOR END-TO-END WELDING OF LINED PIPE

RELATED APPLICATION

This application claims priority from U.S. Provisional Application Serial No. 60/273,658, filed on March 6, 2001.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the welding of two ends of steel pipe together, and particularly to welding of pipe ends together where the pipe is lined with fiberglass.

2. Description of Prior Art

Corrosion in oil and gas pipelines and flow lines continues to be a problem. The most common prevention technique for internal corrosion in the oil and gas industry at this time is coating the inside of the pipe with commercially available plastic or cement. Plastic or cement linings for pipe have proven to be not durable enough during "pigging" operations to prevent damage of the lining and subsequent corrosion of the pipe.

A proven method of preventing corrosion in down hole applications is to line the pipe with glass reinforced epoxy (GRE), or fiberglass liners. Such lines are coupled together with threaded connections. Nevertheless, pipe segments lined with fiberglass for pipeline use must be welded end to end to form the pipeline. Specialized welding techniques have been required to weld fiberglass lined segments together.

Conventional welding techniques commonly used in the pipeline industry damage the fiberglass liners of the pipe. The heat generated by the weld greatly exceeds the working temperature of the liners.

Another concern of welding two pipe end segments together concerns alignment of the two pipes being welded.

A prior method used for welding fiberglass lined pipes without damaging the liners employs a sleeve manufactured by RICE ENGINEERING CORPORATION. The sleeve, called a DUOWELD sleeve, is welded to the pipe's outside diameter prior to the lining operation. A special coupling with a corrosion barrier ring is also provided. DUOWELD sleeves allow an air gap between the outer weld of the sleeves and the coupling. The coupling includes a corrosion barrier ring to provide a continuous corrosion resistant surface on the inside of the lined pipe and coupling.

This prior RICE ENGINEERING method requires pre-welded sleeves and a coupling welded in the field. The two pipes must be "jacked" together to allow a significant amount of compression on the corrosion barrier ring. The DUOWELD product requires a total of four welds on each assembly. Two welds are performed on the sleeves, on each end of the pipe prior to the lining operation. Two additional welds are required to join the sleeves and the coupling after the jacking operation. Although the RICE ENGINEERING method has certain advantages, it has disadvantages of excessive cost due to the additional weld sleeve requirements, and the "jacking" operation.

Another prior method for end-to-end welding of fiberglass lined pipe is provided by CCB INTERNATIONAL. The CCB method utilizes an internal sleeve or fitting that fits inside of the pipe. The sleeve has an insulation material fitted over a PTFE (glass reinforced Teflon), or corrosion resistant alloy (CRA) tube. The inner tube has seal rings which engage

the inside diameter of the liner. The sleeve significantly reduces the inside diameter of the joined pipe segments in the connector/weld area. Reduction of inside diameter at the connection is disadvantageous, because flow through the pipe is significantly restricted in the pipe joint area. Special procedures for tools such as pipeline inside diameter inspection tools, or other tools referred to as pipe line "pigs," are also required. There are concerns about the weld quality, because there are two different materials potentially in contact with the weld.

A common concern during welding operations is the alignment of the two pipes being welded together.

3. Identification of Objects of the Invention

A primary object of the invention is to provide a method and apparatus to weld fiberglass lined pipe segments end-to-end in the field using normal welding procedures.

Another object of the invention is to provide a method and a device for welding fiberglass lined pipe segments end-to-end where only one weld is necessary as compared to the multiple welding steps required when using the DUOWELD sleeve.

Another object of the invention is to provide a method and a device for welding fiberglass lined pipe segments end-to-end where ordinary welding procedures are used as compared to special welding procedures as required in the CCB method.

Another object of the invention is to provide a weld shielding device that protects the fiberglass lining when fiberglass lined pipe segments are welded end-to-end, where the device acts as a centralizer for aligning the two pipe segments together.

Another object of the invention is to provide a weld shielding device that provides a substantially smooth inside diameter of fiberglass lined pipe where the inside diameter has no weld beads or weld splatter common in normal welding operations.

Another object of the invention is to provide a weld shielding device and method for welding fiberglass lined pipe segments end-to-end to provide a substantially smooth transition of the inside diameter across the joining area of the pipe segments so that pigging operation problems of the joined pipe segments are reduced as compared to pigging operations through fiberglass lined pipe segments joined by prior methods and devices.

Another object of the invention is to provide a weld shield device which functions as a spacer for the weld, thereby eliminating the need for tack welding prior to a root weld pass.

Another object of the invention is to provide a device which shields the fiberglass linings of opposed end-to-end segments of fiberglass lined pipes from the high temperature of the weld.

Another object of the invention is to provide a weld shield device to reduce the cost of joining fiberglass lined pipe end-to-end as compared to the CRA tube of CCB INTERNATIONAL.

SUMMARY OF THE INVENTION

The objects identified above as well as other features and advantages are incorporated in a weld shield device that facilitates the welded connection of two pipe segments having fiberglass liners. The weld shield device includes commercially available insulation material applied about the outer surface of a sleeve body. The sleeve body is arranged and designed in coordination with the end profiles of the pipes to be joined to help establish a welding gap between the two pipe segments, and the insulation material reduces the transfer of heat from the welding operations to the fiberglass liners. The weld shield device has end profiles that allow it to couple with the ends of the pipe segments. In this coupling, the weld shield device at least partially occupies a cutout portion of the fiberglass liner.

In a first embodiment of the invention, a long neck of the weld shield device fits in a cutout portion between a fiberglass lining and the pipe segment. A short neck of the weld shield device fits radially inwardly of the end of the fiberglass lining to protect and provide a substantially smooth transition across the joining area. The end of the fiberglass lining of a pipe segment fits within a groove defined by the two necks.

In a second embodiment of the invention, the weld shield device couples with an adhesive material surface and a fiberglass-lining surface. A short neck of the weld shield device fits radially inwardly of the end of the fiberglass lining to protect and provide a substantially smooth transition across the joining area.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described by reference to the drawings of which,

Figure 1 is a one-half cross-section of two pipe sections which are lined with fiberglass lining and have been welded end to end together while using a weld shield device according to a first embodiment of the invention;

Figure 2 is a one-half cross-section of the weld shield device of Figure 1;

Figure 3 is a one-half cross-section of two pipe sections which are lined with fiberglass lining prior to welding end-to-end with a weld shield device according to a second embodiment of the invention; and

Figure 4 is a one-half cross-section of the weld shield device of Figure 3.

DESCRIPTION OF THE INVENTION

The invention is defined by the claims attached hereto with Figure 1 illustrating one embodiment of the invention showing a weld shield device 10 facilitating the connection of two pipe segments (100A, 100B) using weld material 200 and conventional welding

procedures. The two pipe segments (100A, 100B) include steel pipes (130A, 130B) which are lined with fiberglass linings (120A, 120B), which are secured to the pipes with adhesive material (110A, 110B). (The Figures are not to scale, and dimensions are exaggerated for clarity.)

Prior to installation of the weld shield device 10 in Figure 1, the pipe segments (100A, 100B) ends are prepared for the welding operations by first removing the ends of the fiberglass lining (120A, 120B) from the end of a pipe segment (100A, 100B) by a length 125. Next, the adhesive material (110A, 110B) is removed between the fiberglass lining (120A, 120B) and the inside diameter 300 of the pipe segment (100A, 100B) by a length 115.

Referring to Figures 1 and 2, the weld shield device 10 includes a sleeve body 20 and insulation material 30 lapped about the outside diameter of the sleeve body 20. A pair of long necks 60 and short necks 50 extend outwardly axially from the body 20 of weld shield device 10. A groove 40 is defined on each side of the weld shield device 10 between the long necks 60 and short necks 50. The long necks 60, short necks 50, and grooves 40 make up the end profiles 70. A profile 70 is provided on opposite ends of the device 10. The end profile 70 is designed to compliment the characteristics of the prepared pipe segment (100A, 100B). For example, long neck 60 fits within the cutout portion between the fiberglass lining 120A and the pipe segment 100A where the adhesive material has been removed, and the groove 40 accepts the protrusion of fiberglass lining (120A, 120B). Correspondingly, the radial thickness 31 of the long neck 60 is slightly smaller than the radial thickness 113 of the adhesive material (110A, 110B), and the thickness 123 of the fiberglass linings (120A, 120B) is slightly smaller than the thickness 35 of the groove 40. The end profile 70 in combination with the profile of the prepared pipe segments (100A, 100B) helps to centralize the joint during welding operations.

The dimensions of the weld shield device 10 are designed to allow the weld shield device 10 to act as a spacer. When pipe segment 100A and pipe segment 100B are coupled to the weld shield device 10, a weld gap 230 of a predetermined length 17 exists. The weld gap 230 is primarily created via the relationship between the sleeve body 20 and the cutout portion of fiberglass liners (120A, 120B). That is, when the groove 40 contacts the fiberglass liners (120A, 120B) at a mating surface 122, the contact of the liners in the groove 40 prevents the pipe segments (100A, 100B) from moving any closer together to one another. In the embodiment of Figure 1, the length 15 of the sleeve body 20 is approximately the same size as cutout portion length 125 of fiberglass liner 120A, cutout portion length 125 of fiberglass liner 120B, and predetermined length 17 of weld gap 230. The mating of the long necks 60 with the ends adhesive material (110A, 110B) at mating surface 112 can, also aid in creating the weld gap 230. The length 11 of the outer side 80 of the weld shield device 10 being approximately the same length as the cutout portion length 115 of adhesive material 110A and cutout portion length 115 of adhesive material 110B, and predetermined length 17 of weld gap 230.

The insulation material 30 is any one of many commercial materials which are known to those skilled in the art. The insulation material is a silica matrix, preferably UNIFRAX® brand of sticky putty from UNIFRAX Corporation. Such insulation material prevents transfer of heat from the welding operation at gap 230 to the fiberglass portions 120A, 120B. Preferably, as shown in the embodiment of Figure 1, the insulation material 30 spans the entire distance of the outer side 80 of the weld shield device 10.

The sleeve body 20 is preferably designed to withstand corrosion and is durable enough to withstand pigging operations. It can be made of CRA material, composite material, solid insulating material, or the like.

The method for joining the two ends of the pipe segments of Figure 1 begins after the ends of the pipe segments (100A, 100B) have been prepared as described above, by installing the weld shield device 10 on the end of one pipe segment, e.g. 100A. The weld shield device 10 mates with the fiberglass lining 120A at mating surface 112 and the adhesive material 110A at mating surface 122 allowing the outer side 80 of the weld shield device to lie adjacent to piping 130A. If desired, the weld shield device 10 can be fixed in place using an epoxy resin, sealant material, or the like. Next, pipe segment 100B is installed onto the other end of the weld shield device 10 in a similar manner. Once again, if desired, an epoxy resin, sealant material, or the like can be used to help fix the weld shield device 10 in place.

After connection of the two pipe segments (100A, 100B), conventional welding is performed using weld material 200. The embodiment of Figure 1 shows the pipe segments (100A, 100B) with weld preparation angles 240. These weld preparation angles 240 create a welding area that is in communication with the weld gap 230. As previously mentioned, the dimensions of the weld shield device 10 create the weld gap 230 between the pipe segments (100A, 100B). The end profile 70 of the weld shield device 10 having a complimentary profile to prepared pipe segments (100A, 100B) helps centralize and stabilize the pipe during welding operations. Additionally, the insulation material 11 of the weld shield device 10 reduces transfer of thermal energy from welding operations to the fiberglass linings (120A, 120B) of the two pipe segments (100A, 100B).

Figures 3 illustrates a second embodiment of the invention showing a similar arrangement to that of Figure 1, but with the weld shield device 10' in an alternative configuration and with a correspondingly different preparation of pipe segments (100A, 100B).

Similar to Figure 1, prior to the installation of the weld shield device 10', the pipe segment ends (140A, 140B) are prepared. However, a length 135 is removed from both the adhesive material (110A, 110B) and fiberglass lining (120A, 120B).

Referring to Figures 3 and 4, the details of the alternatively configured weld shield device 10' can be seen. The insulation material 30' is lapped about sleeve body 20'. The insulation material 30' is thicker in a central portion of the weld shield device 10'. To keep a constant thickness 35' in the weld shield device 10', the sleeve body 20' is correspondingly thinner in the central portion than that shown in the embodiment of Figure 2. The preferred material of sleeve body 20' is stainless steel or a composite. The shoulder 40' is dimensioned to compliment the removal of length 135 of the adhesive material (110A, 110B) and fiberglass lining (120A, 120B). The short neck 50' is disposed radially inwardly around the adhesive material 120A. The short neck 50' is designed to extend around the fiberglass linings (120A, 120B) to help protect the insider diameter 320 of the fiberglass liners (120A, 120B) and the end of the fiberglass liners (120A, 120B). Preferably, the short neck 50' makes only a small radial intrusion into the inside the diameter 320 of the fiberglass linings (120A, 120B) thereby facilitating smooth, uninterrupted flow in the joint area. The length 19 of weld shield device 10' helps create weld gap 230: that is, the length 19 is roughly the same size as the cutout portion length 135 of adhesive material 110A/fiberglass lining 120A, cutout portion length 135 of adhesive material 110B/fiberglass lining 120B, and predetermined length 17 of weld gap 230.

Similar to the embodiment of Figure 1, the method for joining the two ends of the pipe segments of Figure 3 begins after the ends of the pipe segments (100A, 100B) have been prepared by installing the weld shield device 10' of pipe segment, 100A. The weld shield device 10' mates against the fiberglass lining 120A and adhesive material 110A while the

outside end 80' lies adjacent to the pipe 130 A. If desired, the weld shield device 10 can be fixed in place using an epoxy resin, sealant material, or the like. Then, the other pipe segment 100B is installed on the other end of weld shield device 10' in a similar manner.

After connection of the two pipe segments (100A, 100B), conventional welding is performed using weld material 200 in a manner similar to that of Figure 1.

It should be understood that the invention is not limited to the exact details of construction, operation, or embodiments shown and described, as obvious modifications and equivalents will be apparent to one skilled in the art. For example, while preparation of the pipe segments (100A, 100B) is described as directly preceding installation of the weld shield device 10 or 10', the pipe preparation can occur in the manufacturing stages of the pipe segments (100A, 100B). Also, while the weld shield device (10 or 10') is described as aiding in creating a weld gap 230, such a description should not be interpreted as precluding the use of another device to aid in establishing the weld gap 230. In other words, in some embodiments of the invention, an additional device may be used. Accordingly, the invention is therefore limited only by the scope of the claims.